CHAPTER 7 – HEAVY DUTY TRUCK MODEL

INTRODUCTION

The SCAG Year 2003 Regional Model incorporates a computerized truck model, which estimates trip generation, distribution, and traffic assignment for Heavy-Duty Trucks (HDT). According to the California Air Resources Board (CARB), a heavy-duty truck is defined as a truck with a gross vehicle weight of 8,500 pounds or more. The HDT Model is fully integrated with the SCAG Regional Transportation Model. It employs truck trip generation rates, and uses a network of regional highway facilities for truck traffic assignment. The truck traffic assignment process is integrated with the assignment process for light-and-medium duty vehicles in the Regional Model, so that the effects of congestion on truck route choice are represented. The integration of the trip assignment process for both models is necessary so that the effects of truck activity on light-and-medium duty vehicles in the traffic stream are also represented.

A primary objective is to improve the current internal trip generation model by re-estimating the truck trip production and attraction rates for certain land use/employment sectors. The re-estimation of trip productions and attractions will be at the new zone system (4109 internal TAZs).

The HDT Model is extensively documented in a separate report recently prepared for SCAG. The contents of this Chapter is limited to a brief overview of the Model, and a discussion of how the HDT Model was used to generate and distribute heavy-duty truck trips for the Year 2003 Model Validation Run. The assignment and Vehicle Miles Traveled (VMT) results for the HDT traffic component of the Model are presented in Chapter 8.

DESCRIPTION OF HEAVY DUTY TRUCK MODEL

The HDT Model is designed to develop forecasts of heavy-duty trucks in the following three Gross Vehicle Weight (GVW) categories:

- Light-Heavy Trucks: 8,500 to 14,000 pounds GVW
- Medium-Heavy Trucks: 14,000 to 33,000 pounds GVW
- Heavy-Heavy Trucks: over 33,000 pounds GVW

The Model is specifically designed to forecast truck movements in the Region for air quality conformity determinations. As such, it produces VMT estimates for the three truck weight classifications identified above. The HDT Model employs socioeconomic data by Traffic Analysis Zone (TAZ), with employment data broken down into further detail by North American Industry Classification System (NAICS) code to better estimate commodity flow demand that correspond to truck travel demand.

External truck trips, trips with a trip end outside of the SCAG Region were developed from estimated incoming and outgoing commodity flows. The internal ending points of those trips are allocated to TAZs within the SCAG Region. Truck trips "internal" to the Region are estimated from shipping and receiving daily truck trip generation rates corresponding to the number of employees in various employment sectors in each zone, and in certain cases, with the number of households in each zone. Special truck activity trip tables were developed for special truck trip generators, such as ports and airports. Truck specific time period factors, derived from California Weigh In Motion (WIM) truck data, were applied to allocate daily truck activity into the four model time periods (A.M. peak, Midday, P.M. peak, and Night). Trucks are converted into passenger car equivalents during the assignment phase. The trip assignment process simultaneously loads both heavy-duty trucks and light-and-medium duty autos/trucks so that all vehicle types are accounted for in the traffic stream.

Internal Truck Trip Generation Rates

As indicated in the previous section, the current model trip rates are retained for all the sectors. The internal model trip rates used in the interim version of the model are shown in Table 7-1.

Table 7-1

DAILY TRIP RATES FOR INTERNAL TRUCK TRIP GENERATION

EMPOLYMENT CATEGORY	LIGHT HDV	MEDIUM HDV	HEAVY HDV
Households	0.0390	0.0087	0.0023
Agriculture/Mining/Construction	0.0513	0.0836	0.0569
Retail	0.0605	0.0962	0.0359
Government	0.0080	0.0022	0.0430
Manufacturing	0.0353	0.0575	0.0391
Transportation/Utility	0.2043	0.0457	0.1578
Wholesale	0.0393	0.0650	0.0633
Other	0.0091	0.0141	0.0030

Notes: Rates are per household or per employee in each category.

Truck Trip Generation and Distribution

The internal truck trip generation model uses a cross classification methodology using 1-digit employment categories by truck weight class. The internal truck trip generation summary is provided in Table 7-2.

The external truck trips are generated and distributed using a combination of commodity flow data at the county level and 2-digit employment data for allocating county data to

TAZs. External to external truck trips were developed based on observed traffic counts at the external stations and the commodity flow data.

Port related truck trips were developed by using Port of Long Beach's quick trip models for trip generation and the new gate surveys that provided the distribution information of these trips. Air cargo trip tables for Year 2003 were developed by another consultant with the proprietary RADAM model.

The average internal truck trip length in miles for all is 5.92 for Light, 13.06 for Medium, and 24.11 for Heavy.

Table 7-2

YEAR 2003 HEAVY-DUTY VEHICLE INTERNAL TRIP GENERATION BY COUNTY AND BY SECTOR

COUNTY	Light HDV	Medium HDV	Heavy HDV	TOTAL
Imperial	3,789	2,743	3,326	9,859
Los Angeles	247,792	161,873	198,060	607,724
Orange	77,059	59,087	68,905	205,051
Riverside*	39,890	28,049	24,796	92,735
San Bernardino*	43,858	27,401	31,772	103,032
Ventura	19,215	14,547	14,406	48,169
ALL COUNTIES	**431,604**	**293,700**	**341,265**	**1,066,569**

SECTOR	Light HDV	Medium HDV	Heavy HDV	TOTAL
Households	216,441	48,283	12,764	277,488
Ag/Mining/Const	24,667	40,199	27,360	92,226
Retail	48,273	76,757	28,644	153,674
Governments	1,861	512	10,004	12,377
Manufacturing	30,509	49,697	33,794	114,000
Transportation/Utility	69,363	15,516	53,575	138,454
Wholesale	0	0	161,775	161,775
Other	40,490	62,737	13,348	116,575
ALL SECTORS	**431,604**	**293,701**	**341,264**	**1,066,569**

Truck Trip Assignment

Truck specific time period factors, derived from California Weigh In Motion (WIM) truck data, were applied to allocate daily truck activity into the four model time periods (A.M. peak, Midday, P.M. peak, and Night). Trucks are converted into passenger car equivalents during the assignment phase.

The trip assignment process simultaneously loads both heavy-duty trucks and light-and-medium duty autos/trucks so that all vehicle types are accounted for in the traffic stream.

Truck PCE is estimated for each link by the product of a grade factor and a congestion factor. The grade factors range from 1.2 to 3.6 for Light, 1.5 to 4.5 for Medium, and 2.0 to 6.0 for Heavy HDV. The congestion factors range between 1.0 and 1.3.

The HDT model (developed using 1994 data) was carefully validated against a number of specific parameters including:

- The model estimated Year 2003 truck movements across 23 regional screenlines to within 5.8 percent of the corresponding truck traffic counts (all screenlines combined).
- All differences on individual screenlines were well within allowable tolerances established for regional modeling processes.
- Finally, Year 2003 daily truck VMT was estimated by the HDT Model. The estimate was compared to truck VMT estimates from other statistical sources as part of the model validation process. See Table 8-3.

The truck traffic assignment results are documented in the SCAG regional screenline summaries and in the assignment VMT summaries tabulated and presented in Chapter 8.

POST MODEL ADJUSTMENT OF THE SPEED OF THE HEAVY DUTY TRUCKS

The Year 2003 Model assumes shared lanes for both passenger cars and heavy-duty trucks (HDTs) except for HOV lanes, truck only lanes, and where trucks are prohibited such as the section of Pasadena Freeway north of downtown LA. Both passenger car and trucks are loaded on the same segment of the roadway irregardless of which lanes the HDTs can travel. Therefore, both HDTs and passenger cars would have the same model speed on the same roadway segment. In order to reflect slower speeds that most trucks are traveling, a post model adjustment of the speeds for the trucks was made using the available Freeway Performance Measurement System (PeMS) data. The hypothesis is that heavy-duty trucks travel slower than the passenger cars due to the following:

1. Heavy-duty trucks can only travel on the outside lanes. HDT's choice of travel is relatively limited.
2. The speeds on outside lanes are interfered and thus slowed by incoming and

outgoing vehicles.

3. The acceleration and deceleration of the HDT are much slower than the passenger vehicle.

A linear regression was developed through the analysis of the PeMS database to build the relationship between the speeds of vehicles traveling on the outer freeway lanes and the speeds of vehicles traveling on the inner freeway lanes. This analysis resulted in the following equation:

HDT speed = 0.31 + 0.9657* average freeway speed

The regression R-Square value of the equation is 0.98 and the t statistics for the independent variable is 417.95.

There is no reliable data to derive the speeds of HDT's on arterials. For Year 2003 model, a similar equation is applied to adjust HDT speeds on arterials.